



**IKHANA**



## *2007 Western States Fire Mission*



**Kathleen Howell, Ikhana Flight Operations Engineer**  
**NASA Dryden Flight Research Center**



# *Introduction*



***IKHANA***



## **The NASA Dryden Flight Research Center Ikhana Project Team and Ikhana**



# *Ikhana UAS*



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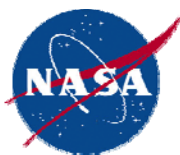
**Ikhana Aircraft**

**Ground  
Control  
Station  
(GCS)**



**OTH KU Antenna**





# *Ikhana UAS / Ground Control Station (GCS)*



## **IKHANA**



## **The Ikhana “Cockpit”**

6/3/2008

EAA AirVenture 2008



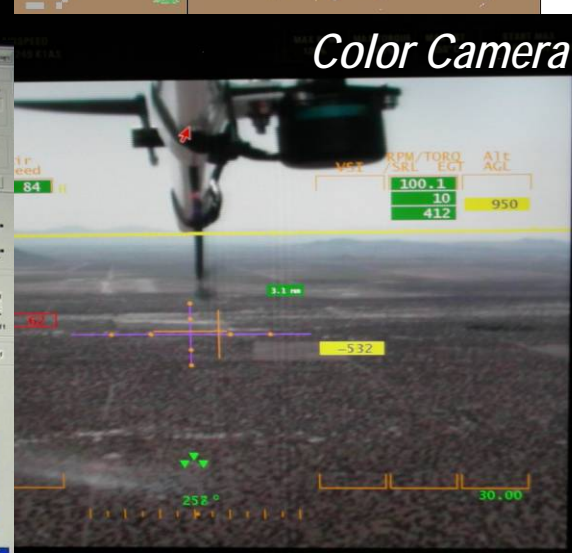
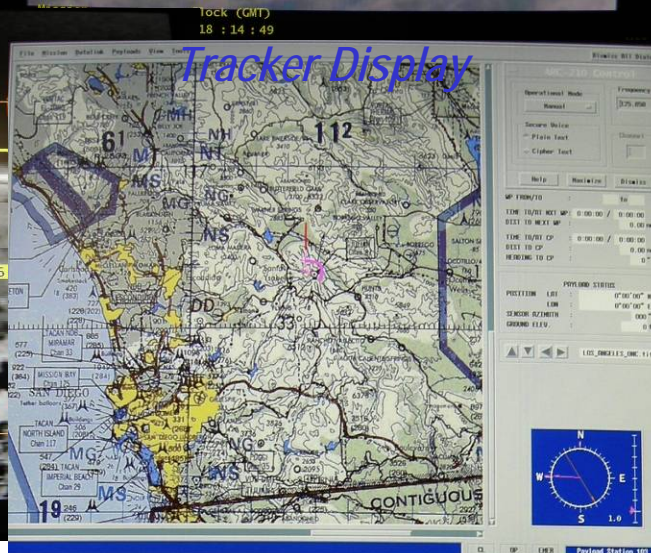
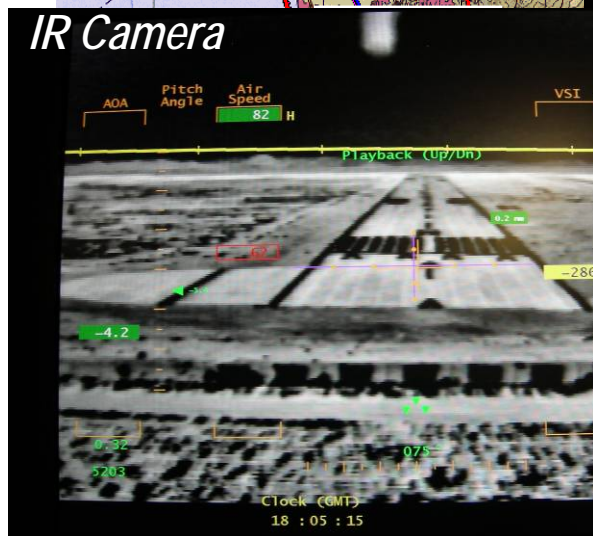
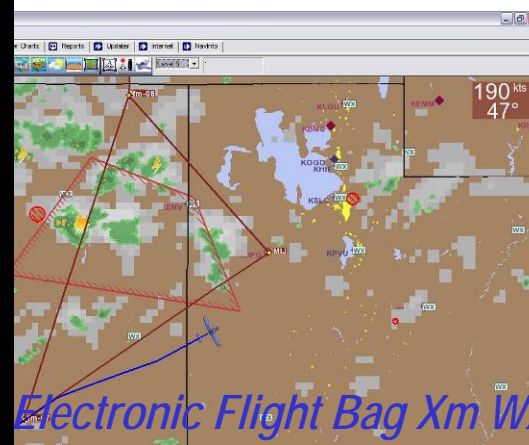
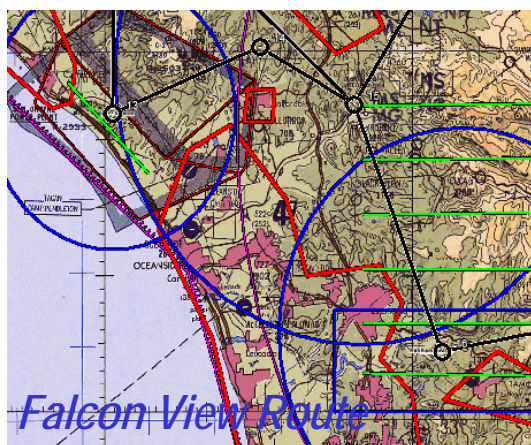


# Ikhana UAS / Ground Control Station (GCS)



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## Pilot Displays for Situational Awareness





# *Ikhana UAS / Ground Control Station (GCS)*



**IKHANA**

## **Mission Control and Research Workstations**





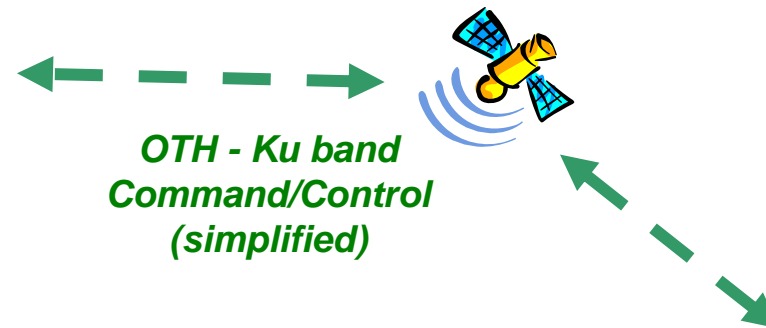


## Ikhana UAS / Antennas



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### Communications with Ikhana and ATC



LOS - C-band  
Command/Control  
(simplified)

**ATC**

Phone







# *Western States Fire Mission 2007 Partners*



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## Science Partners



## Operational Partners





## *Ikhana UAS / Aircraft*



**IKHANA**



**Ikhana with the  
Fire Sensor  
Pod**

**NASA Ames  
Fire Sensor**



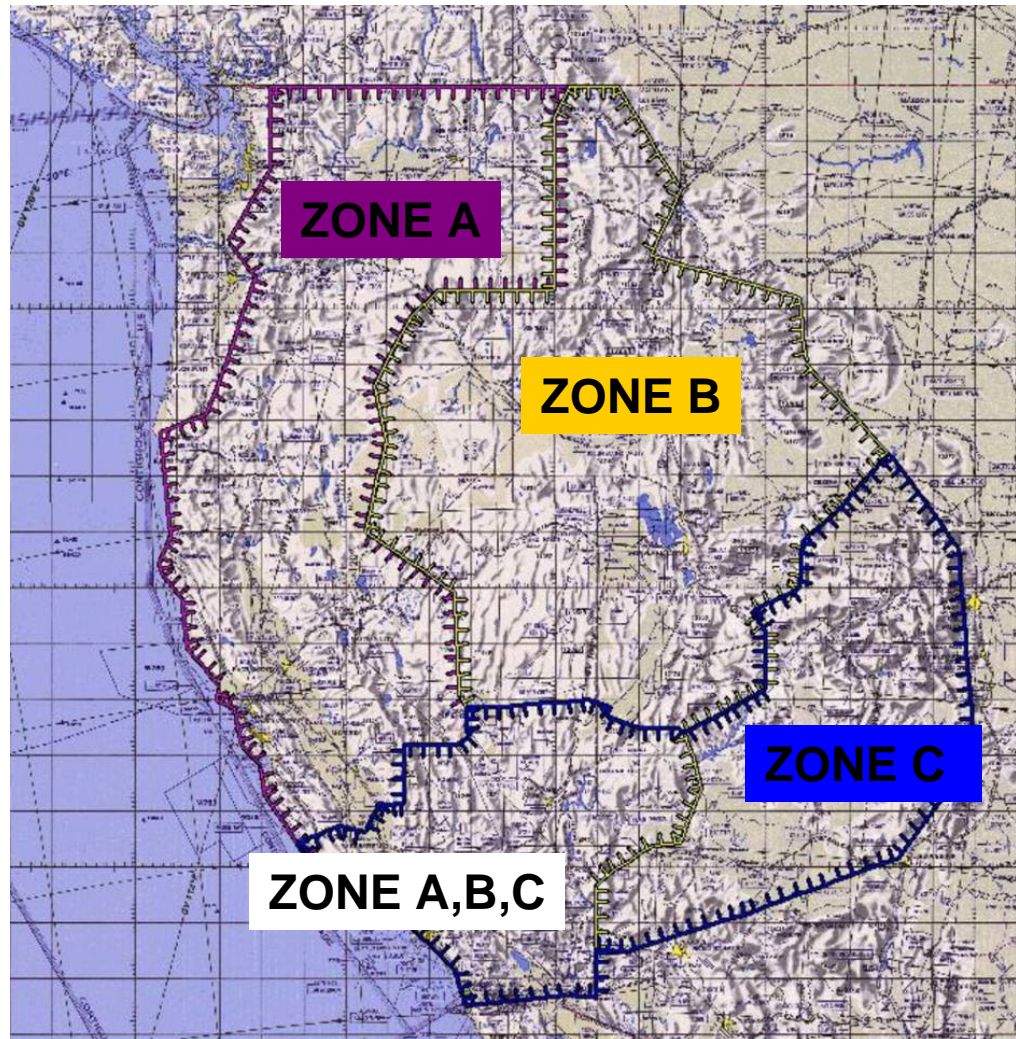


# *FAA Certificate of Authorization (COA)*



**IKHANA**

## **COA Application Boundary**





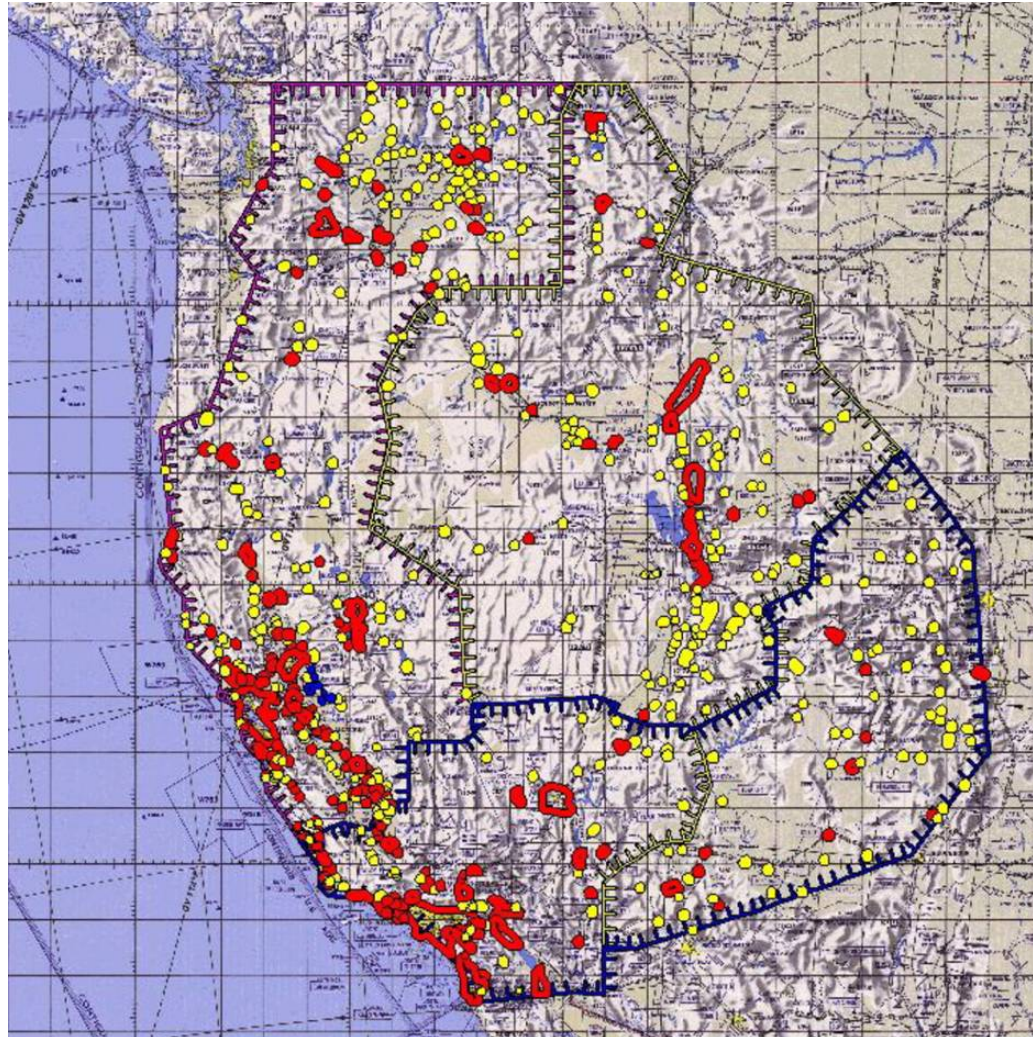


# *FAA Certificate of Authorization (COA)*



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## **Population Keep-Out Zones (Pop KOZ)**





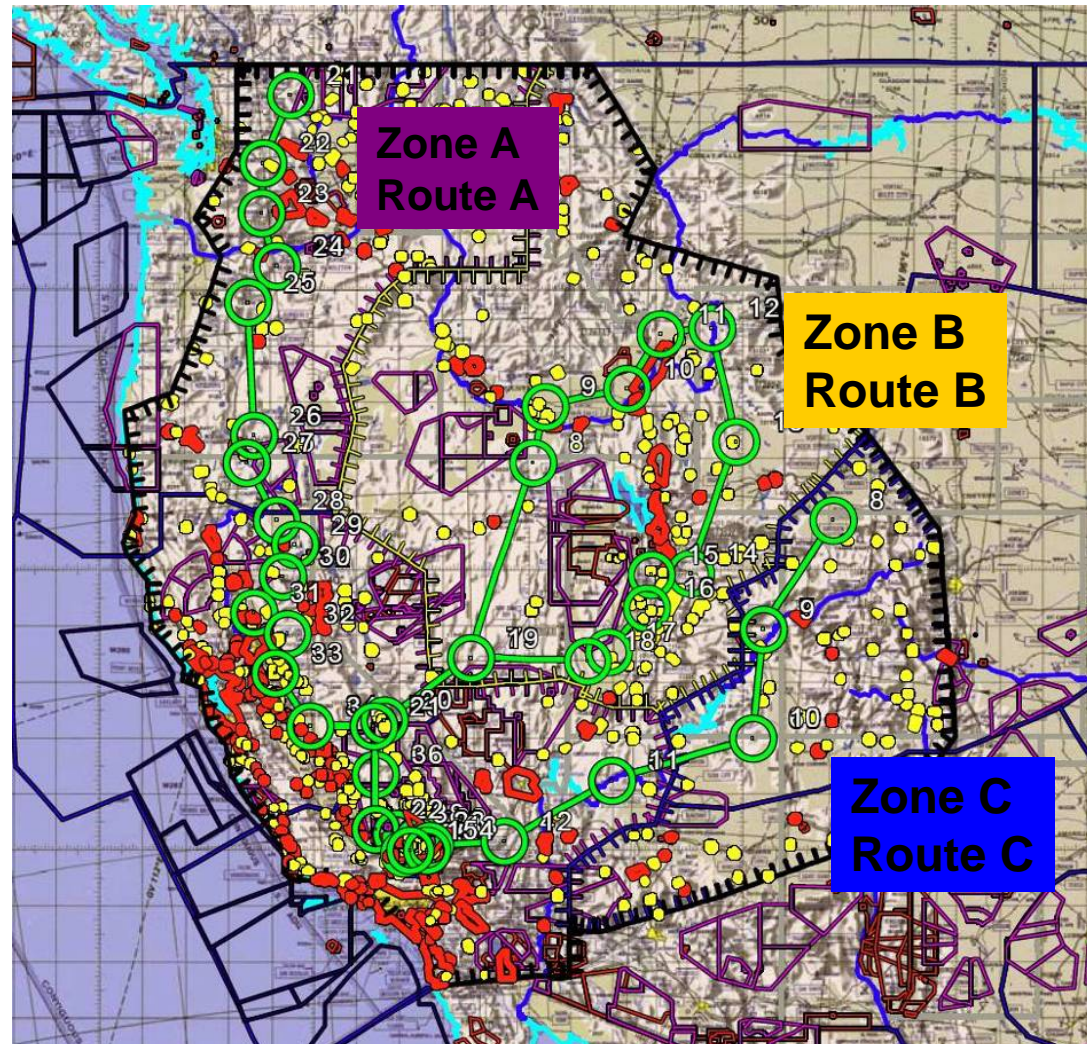


# FAA Certificate of Authorization (COA)



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## “Backbone” Routes





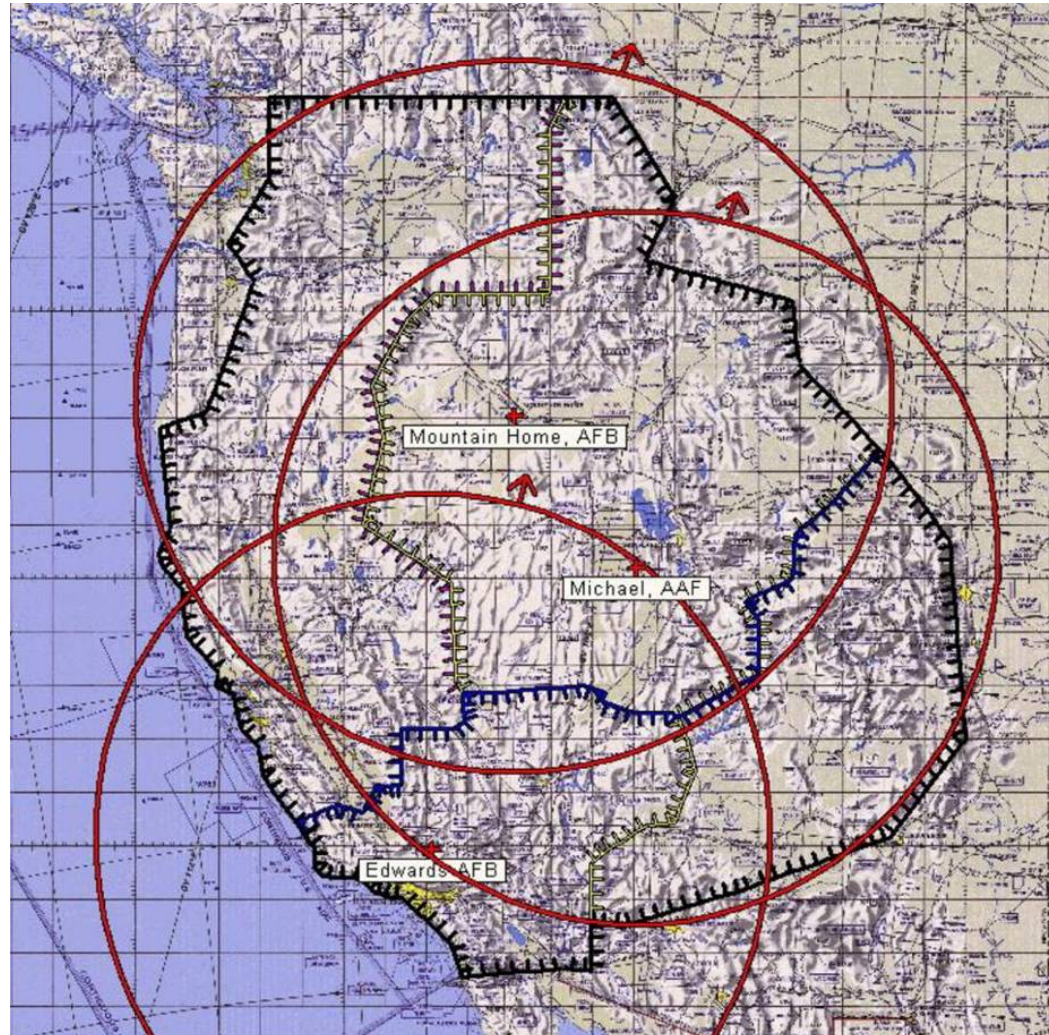


# *FAA Certificate of Authorization (COA)*



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## **Contingency Planning – Primary ELSs**





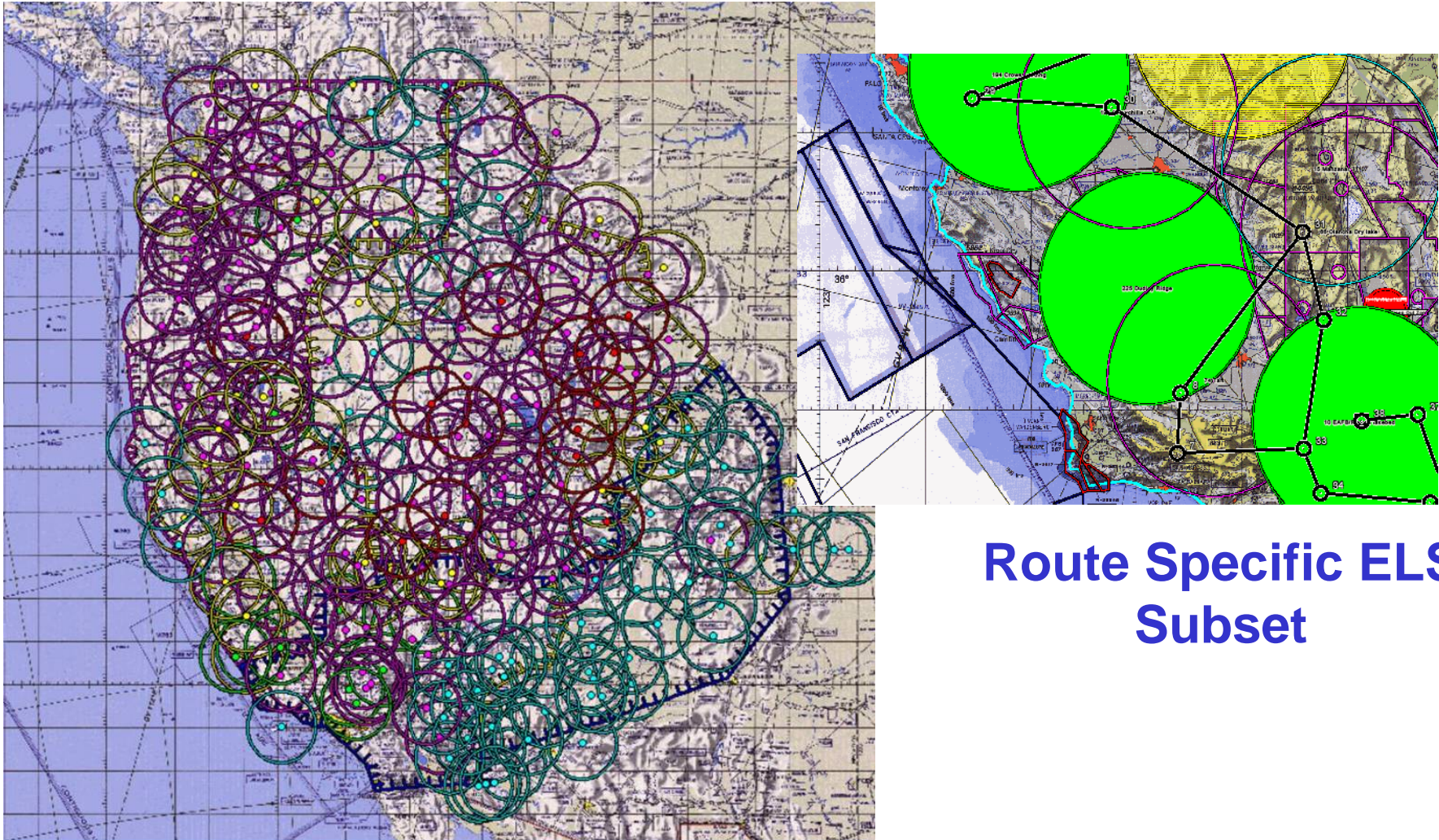


# FAA Certificate of Authorization (COA)



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## Contingency Planning – Secondary ELSs



**Route Specific ELS  
Subset**





# FAA Certificate of Authorization (COA)



## IKHANA

### Pilot ELS Information

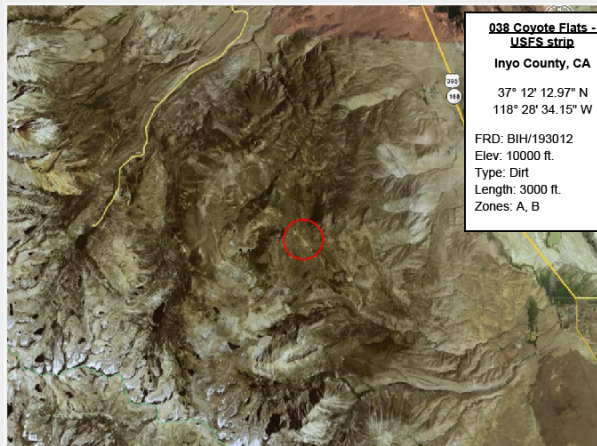
#### 038 Coyote Flats - USFS strip

Inyo County, CA

- 37° 12' 12.97" N
- 118° 28' 34.15" W
- FRD: BIH/193012
- Zones: A, B
- Length: 3000 ft.
- Type: Dirt
- Elev: 10000 ft.
- Sectional: None
- Contact Info:
  - None
- Sheriff Info:
  - Inyo County Sheriff, Bishop
  - 12 Miles
  - Phone 760-873-7887
- WX:
  - BIH ASOS 125.25 13mi NE

Pilot Ranking: 3

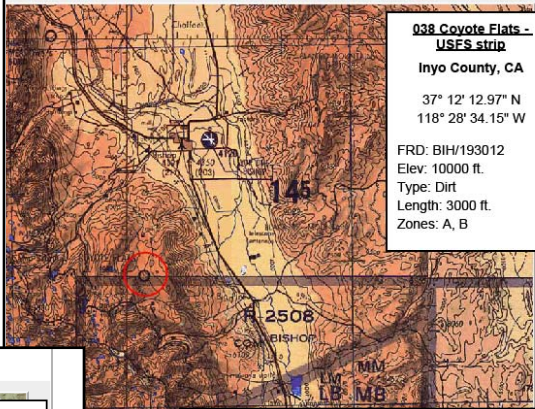
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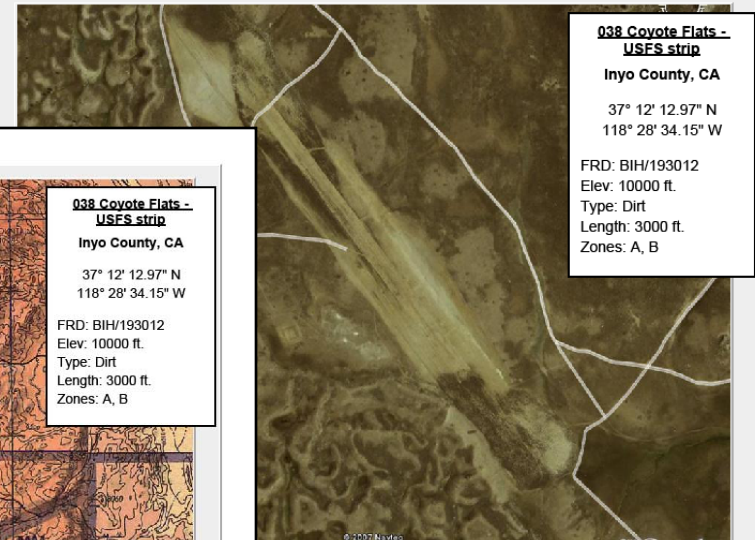
**038 Coyote Flats - USFS strip**  
Inyo County, CA  
37° 12' 12.97" N  
118° 28' 34.15" W  
FRD: BIH/193012  
Elev: 10000 ft.  
Type: Dirt  
Length: 3000 ft.  
Zones: A, B

Page 3

Printed 5/9/2008



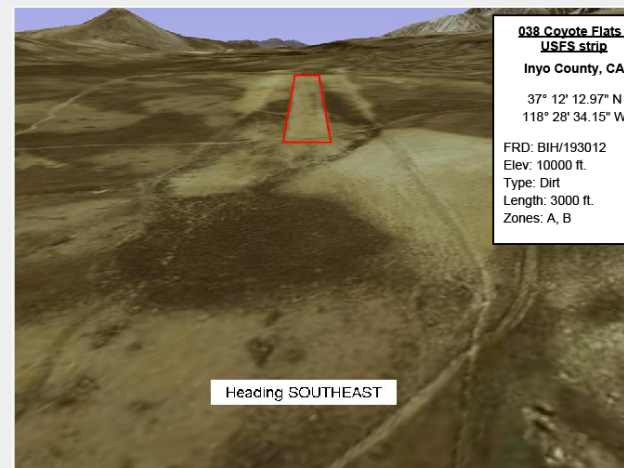
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FRD: BIH/193012  
Elev: 10000 ft.  
Type: Dirt  
Length: 3000 ft.  
Zones: A, B

Printed 5/9/2008

10-30 db



**038 Coyote Flats - USFS strip**  
Inyo County, CA  
37° 12' 12.97" N  
118° 28' 34.15" W  
FRD: BIH/193012  
Elev: 10000 ft.  
Type: Dirt  
Length: 3000 ft.  
Zones: A, B

Heading SOUTHEAST

Page 6

Printed 5/9/2008

10-30 db

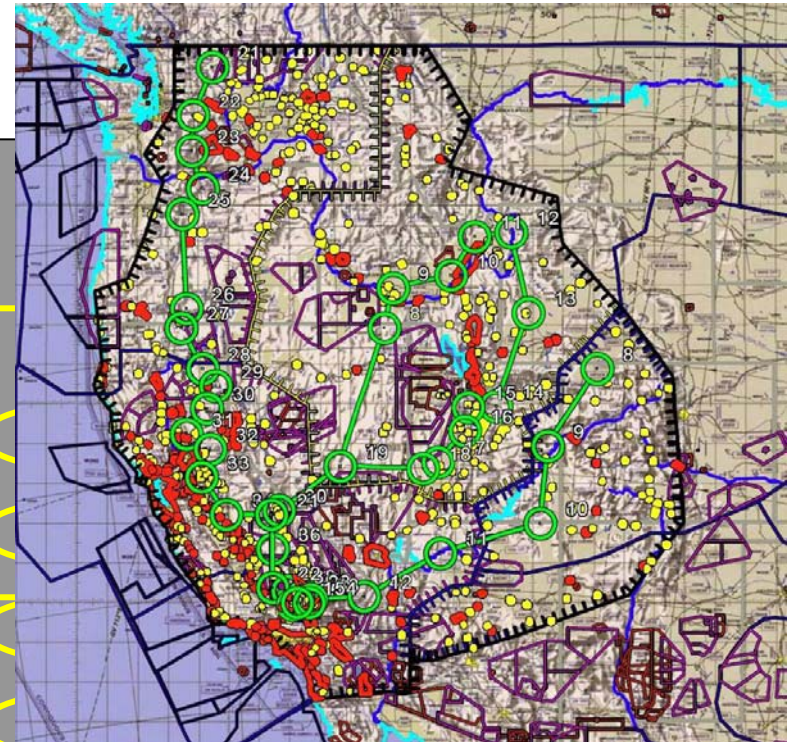
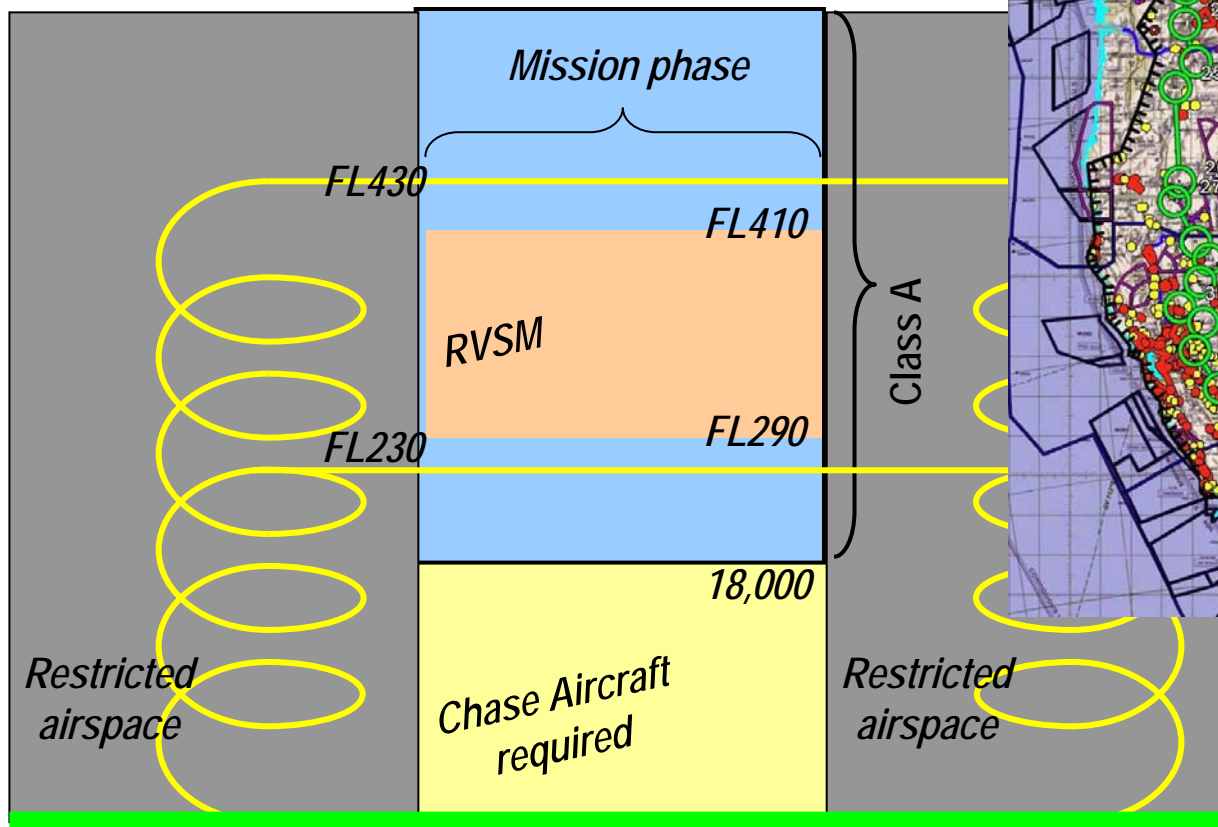


# FAA Certificate of Authorization (COA)



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## Mission Information



## Flight Planning



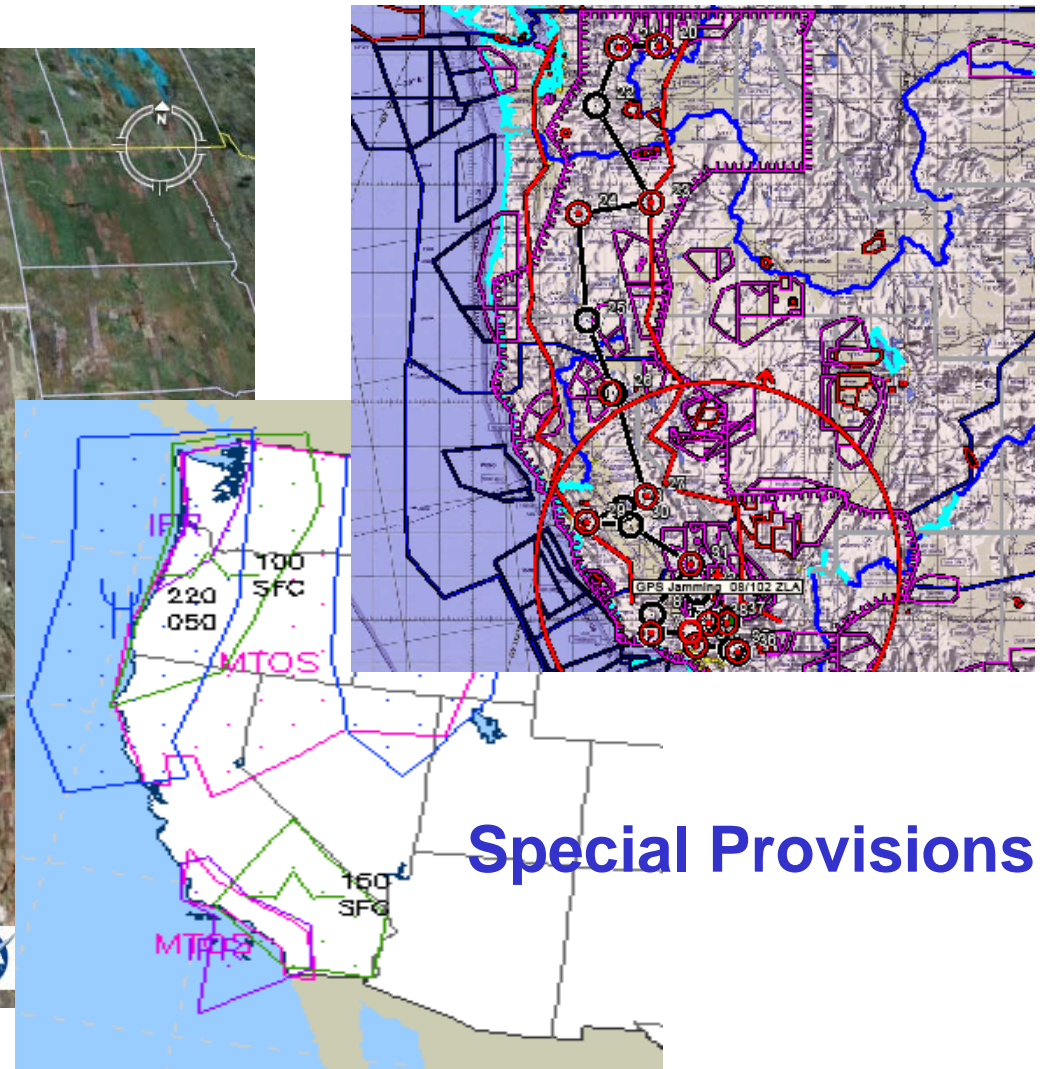
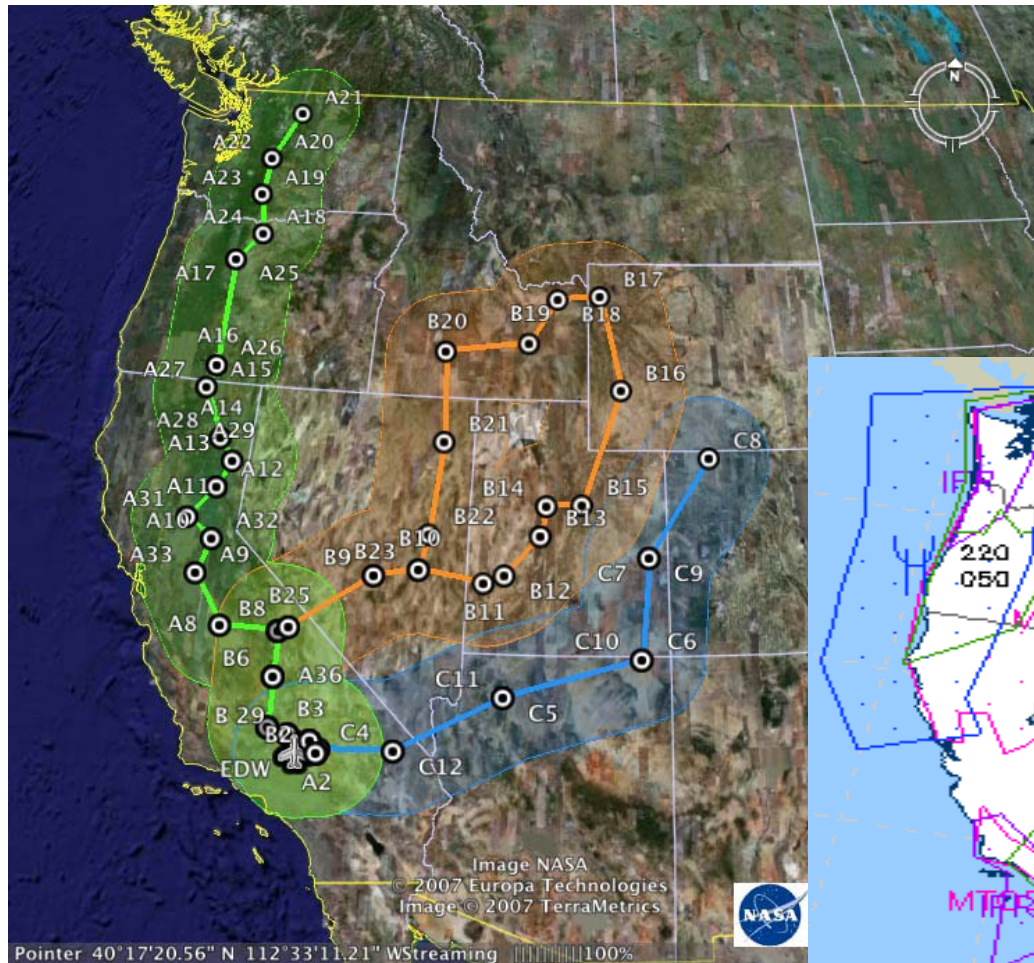


# FAA Certificate of Authorization (COA)



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### Approved COA Area



## Special Provisions





## Western States Fire Missions 2007



### IKHANA

WSFM 1 Aug. 16  
4 Fires, 1400 nm, 9.5 hrs

WSFM 2 Aug. 29 – 30  
7 Fires, 2500 nm, 16.1 hrs

WSFM 3 Sept. 7 – 8  
12 Fires, 3200 nm, 20.0 hrs

WSFM 4 Sept. 27  
BAER, 3 Fires, 1800 nm,  
9.9 hrs





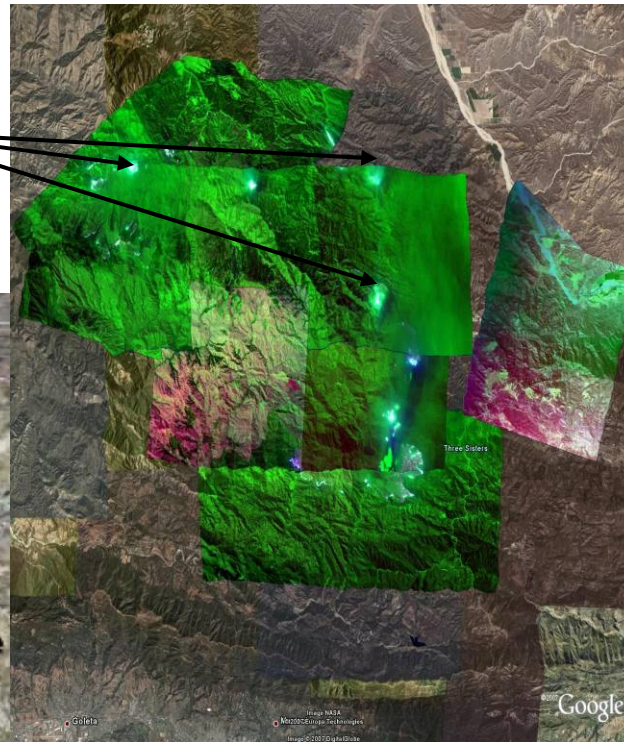


WSFM #1 2007



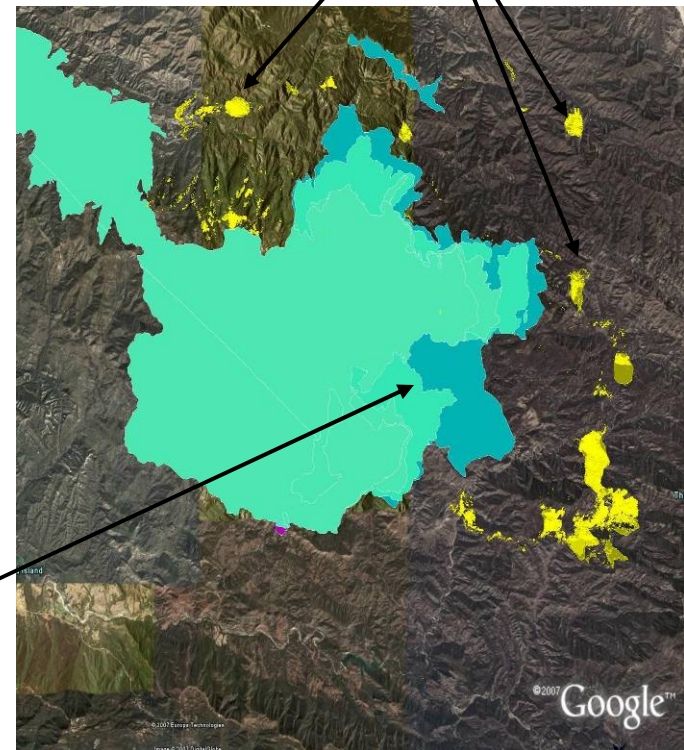
**IKHANA**

*Active  
Fire*



Zaca Fire Images

*Unknown Fire*



*Changing  
Fire  
Perimeter*

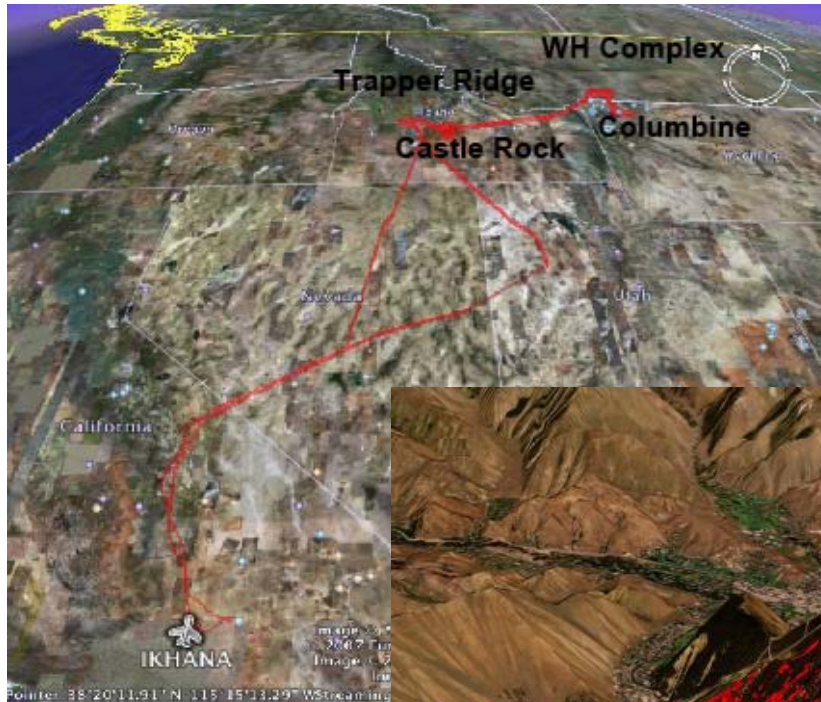




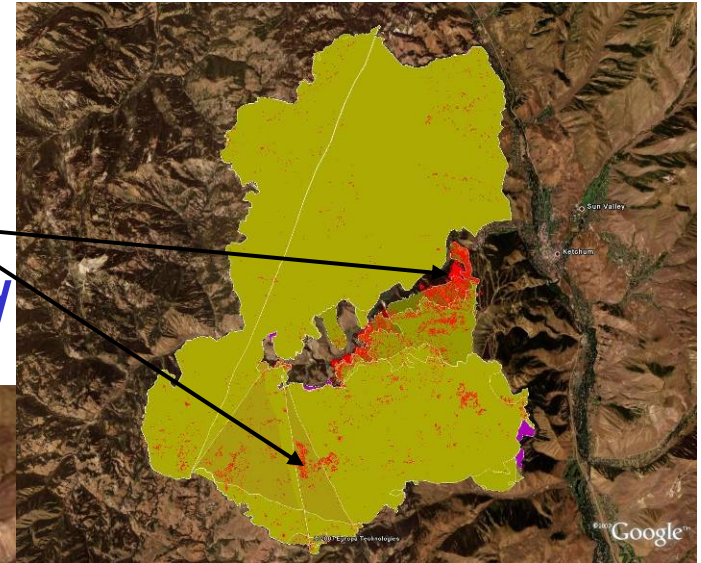
## WSFM #2 2007



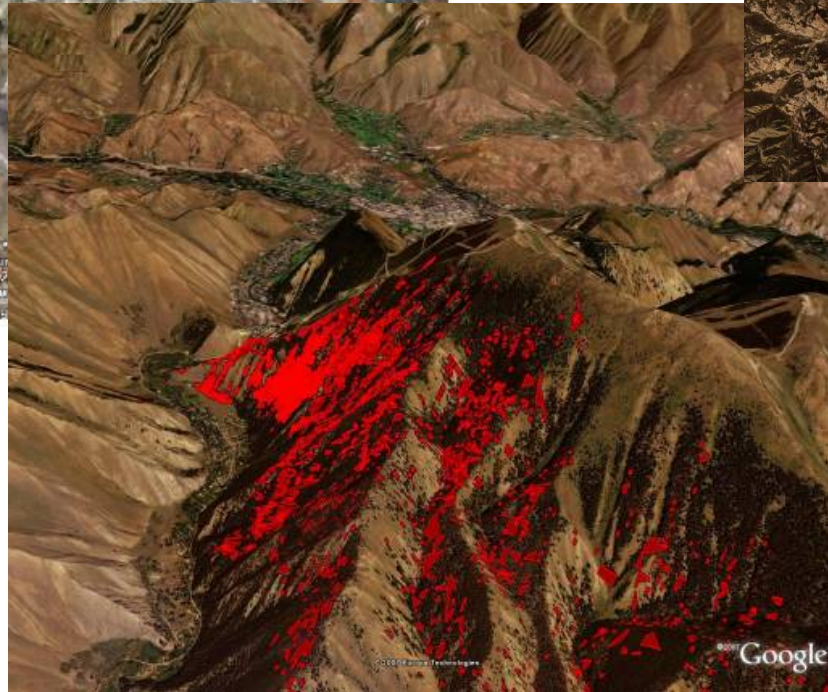
### IKHANA



*New  
Detects  
from  
Overhead*



*3-D View*



**Castle Rock Fire  
Imagery**





## WSFM #3 2007

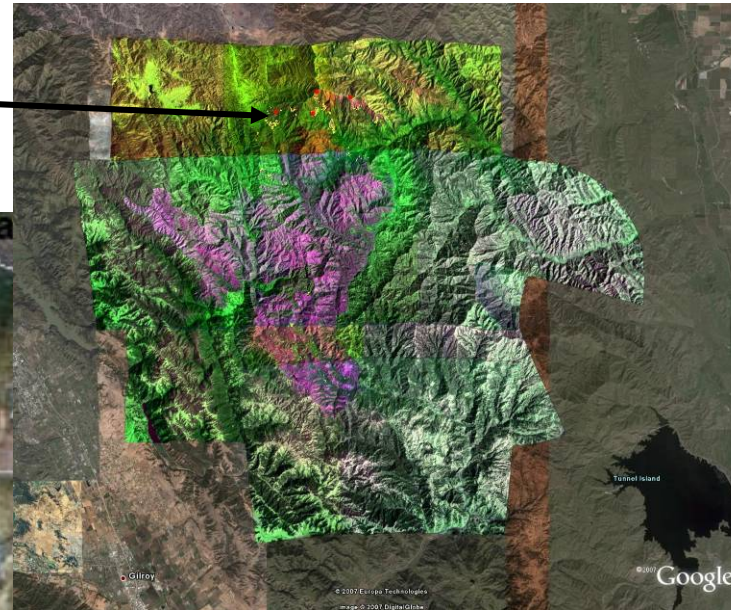


### IKHANA

*Infrared Imagery  
(hot spot)*

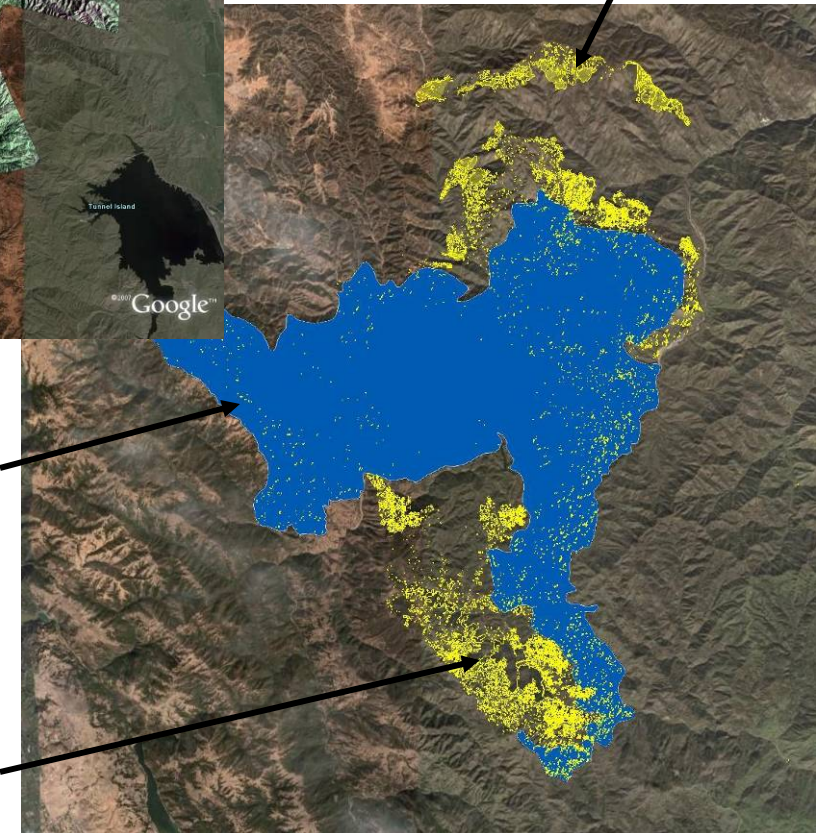
*Lick Fire Imagery*

*Back-Fire*



*Previously  
known fire  
perimeter*

*Active fire*



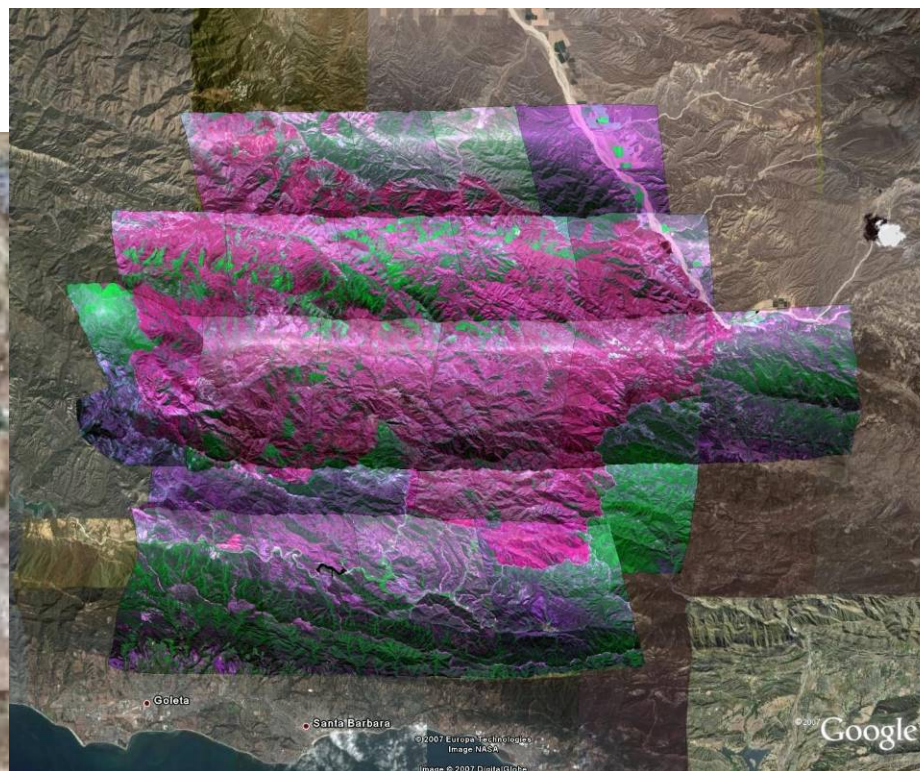
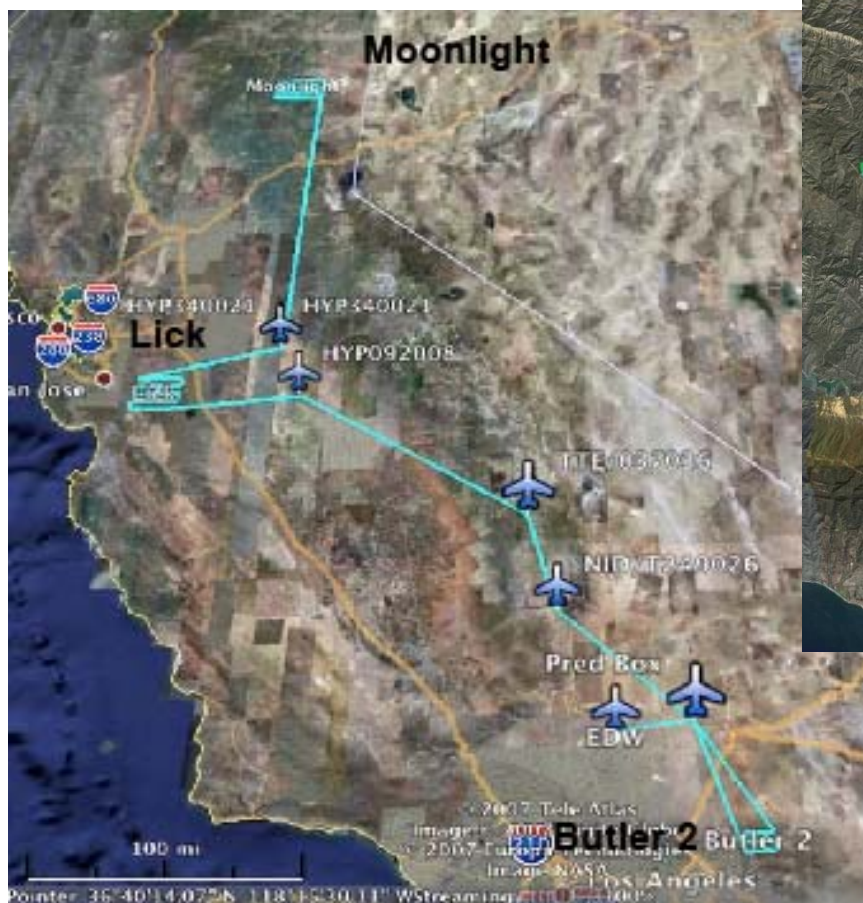




WSFM #4 2007



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**Burn Area Emergency  
Rehabilitation and Stabilization  
(BAER) Assessment Imagery**





# California Wildfire Emergency Response 2007

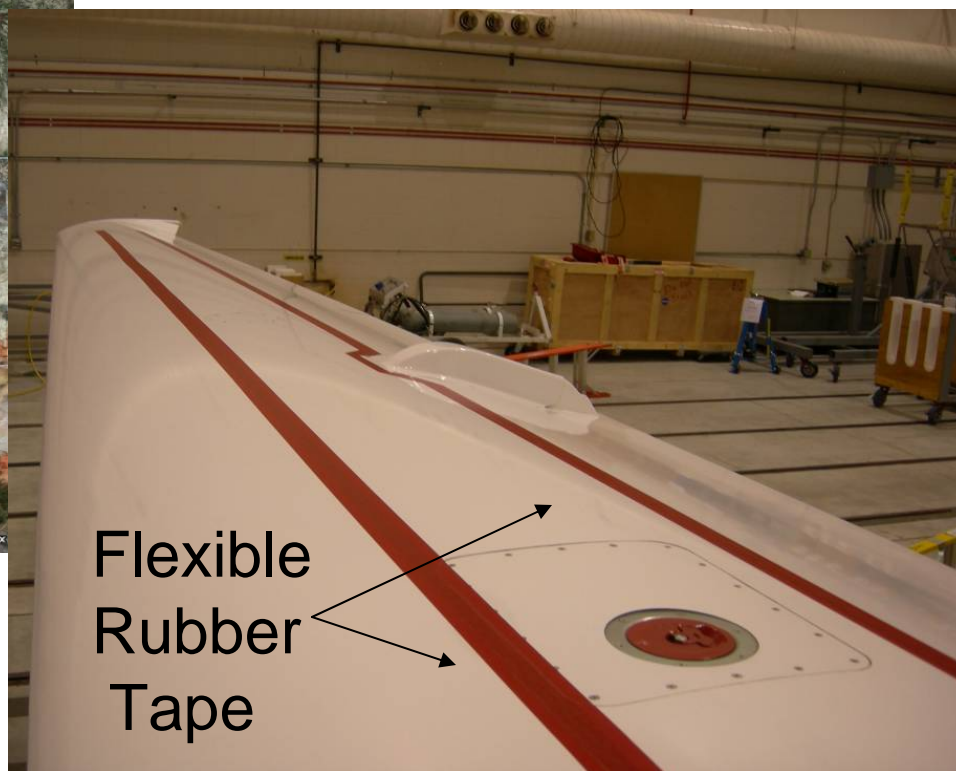


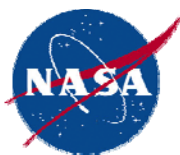
**IKHANA**



**WSFM 2007  
Objectives  
Accomplished**

**New Research  
Configuration**





# California Wildfire Emergency Response 2007



## IKHANA

### WSFM 5

Oct. 24, 11 Fires,  
~1350 nm, 9.0 hrs

### WSFM 6

Oct. 25, 8 Fires,  
~1350 nm, 7.8 hrs

### WSFM 7

Oct. 26, 8 Fires,  
~1350 nm, 7.8 hrs

### WSFM 8

Oct. 28, 8 Fires,  
~1350 nm, 7.1 hrs



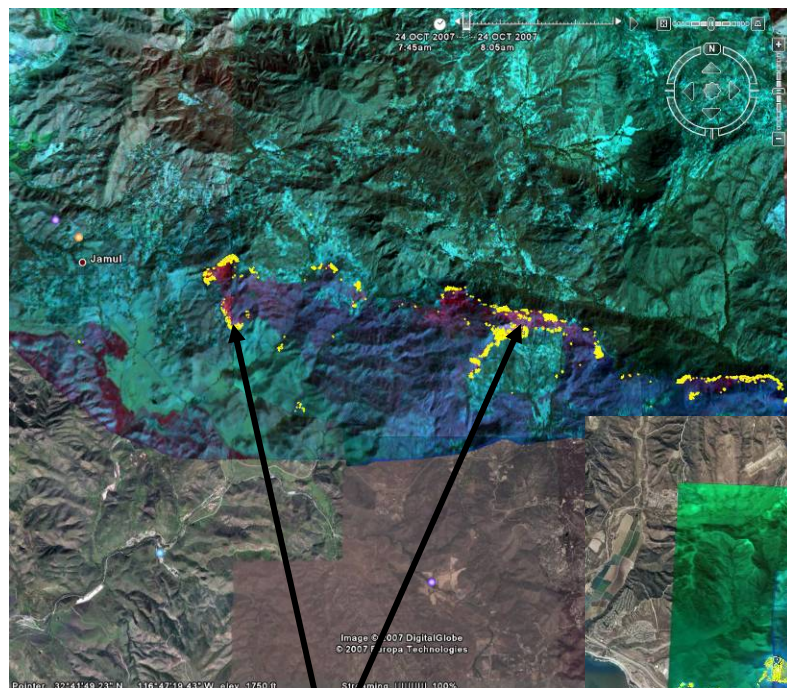




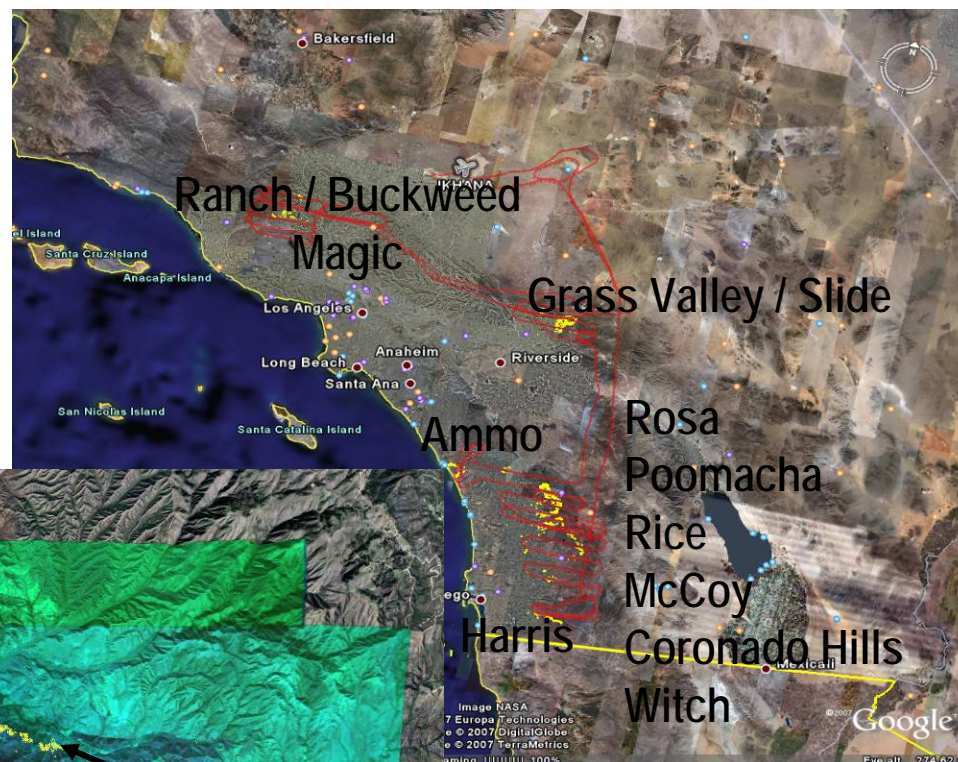
# WSFM #5 Emergency Response 2007



## IKHANA



*Harris Fire  
Hot Detects*



*Ammo Fire  
Hot Detects*

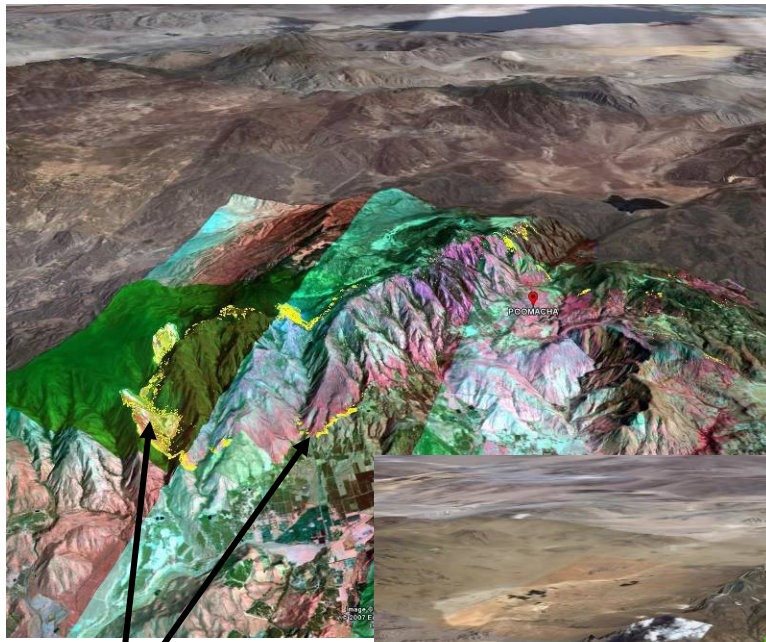




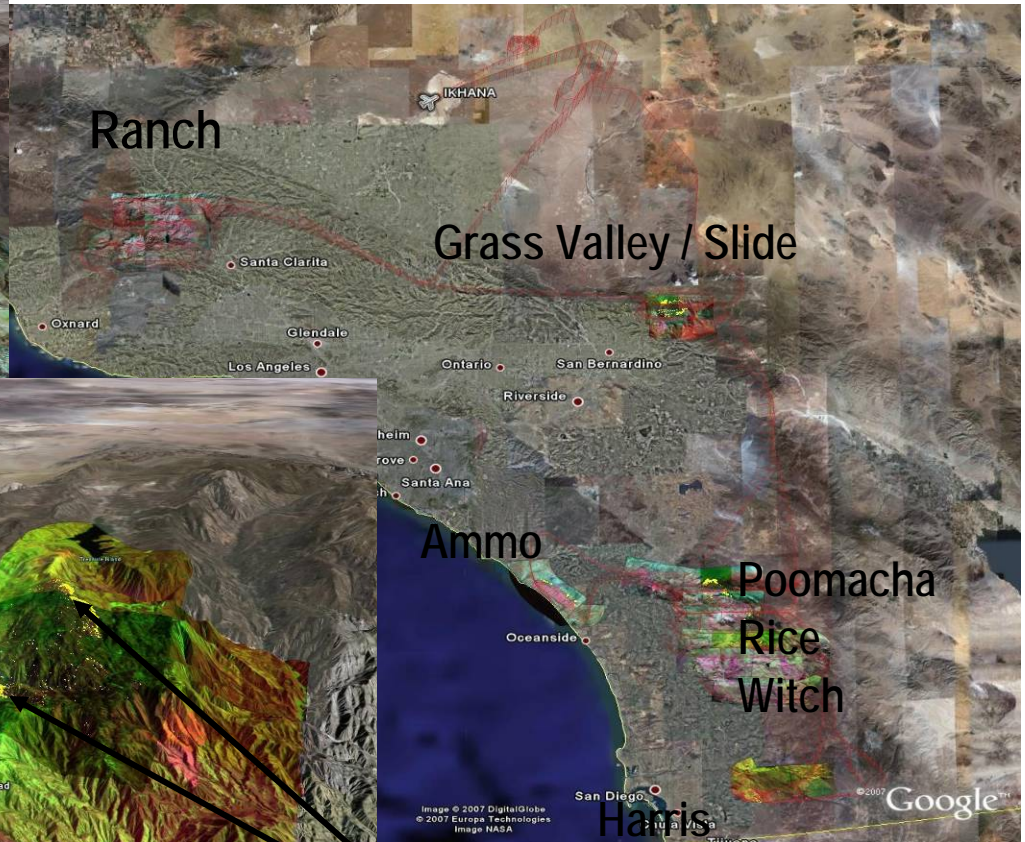
# WSFM #6 Emergency Response 2007



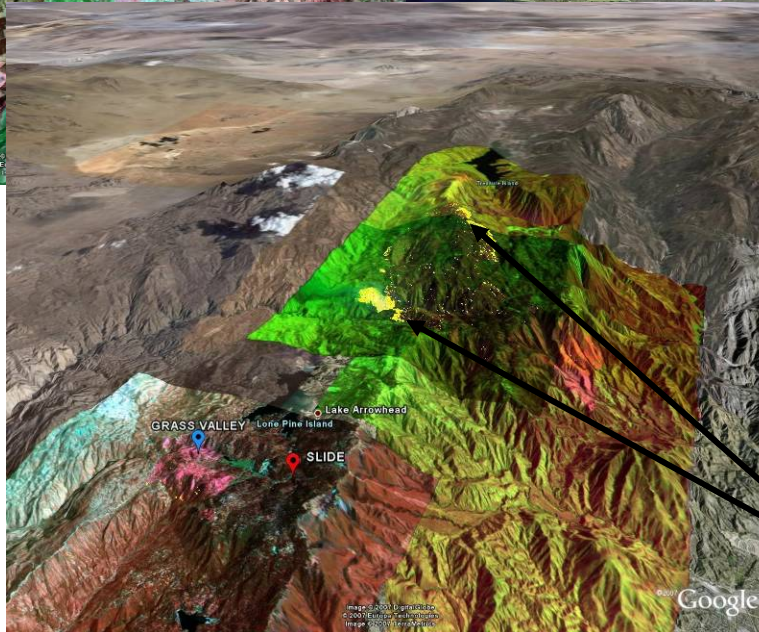
## IKHANA



Poomacha /  
Rice Fires –  
3D with Hot  
Detects



Grass Valley / Slide Fires –  
3D with Hot Detects





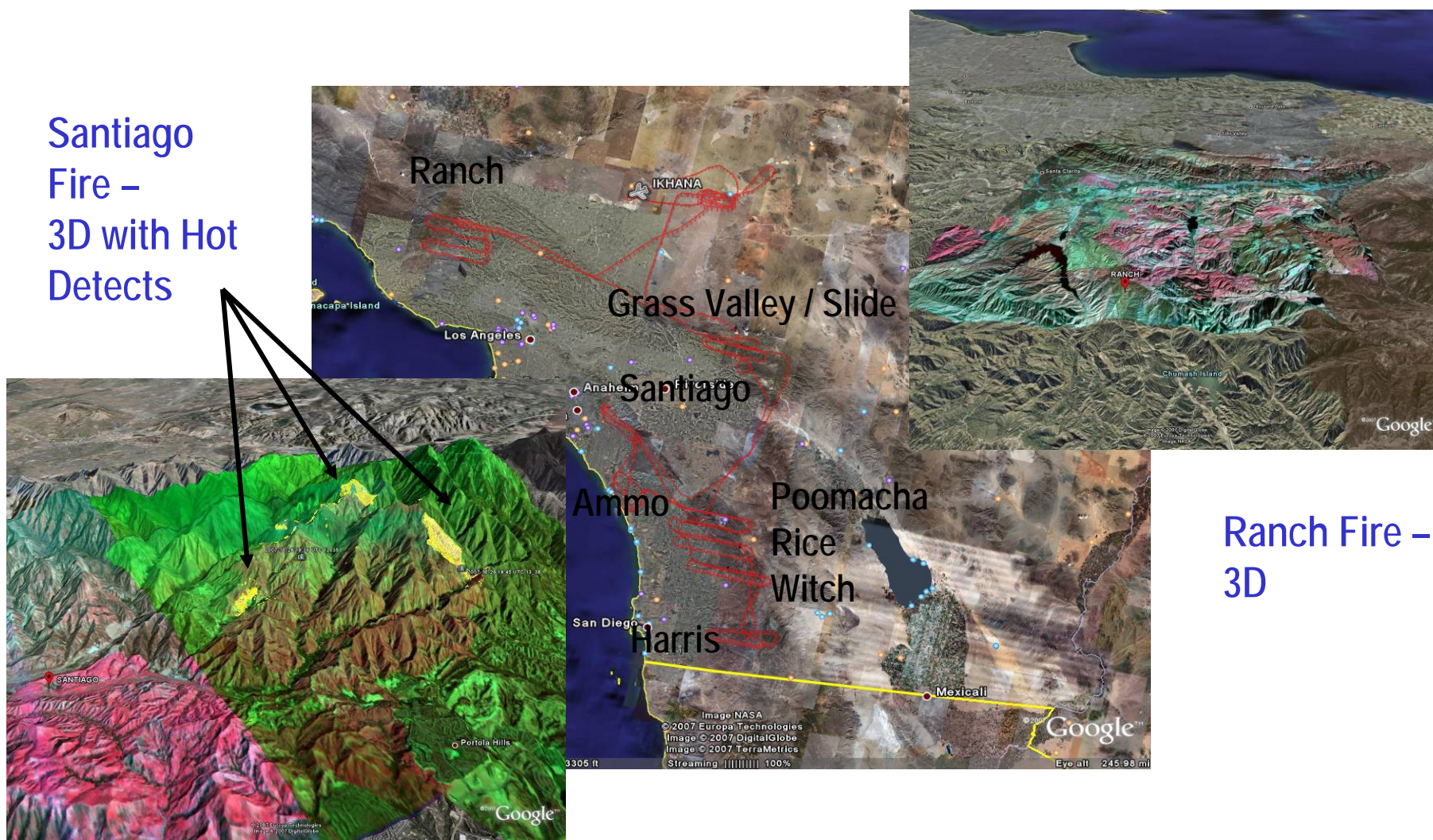


# WSFM #7 Emergency Response 2007



## IKHANA

Santiago  
Fire –  
3D with Hot  
Detects



Ranch Fire –  
3D





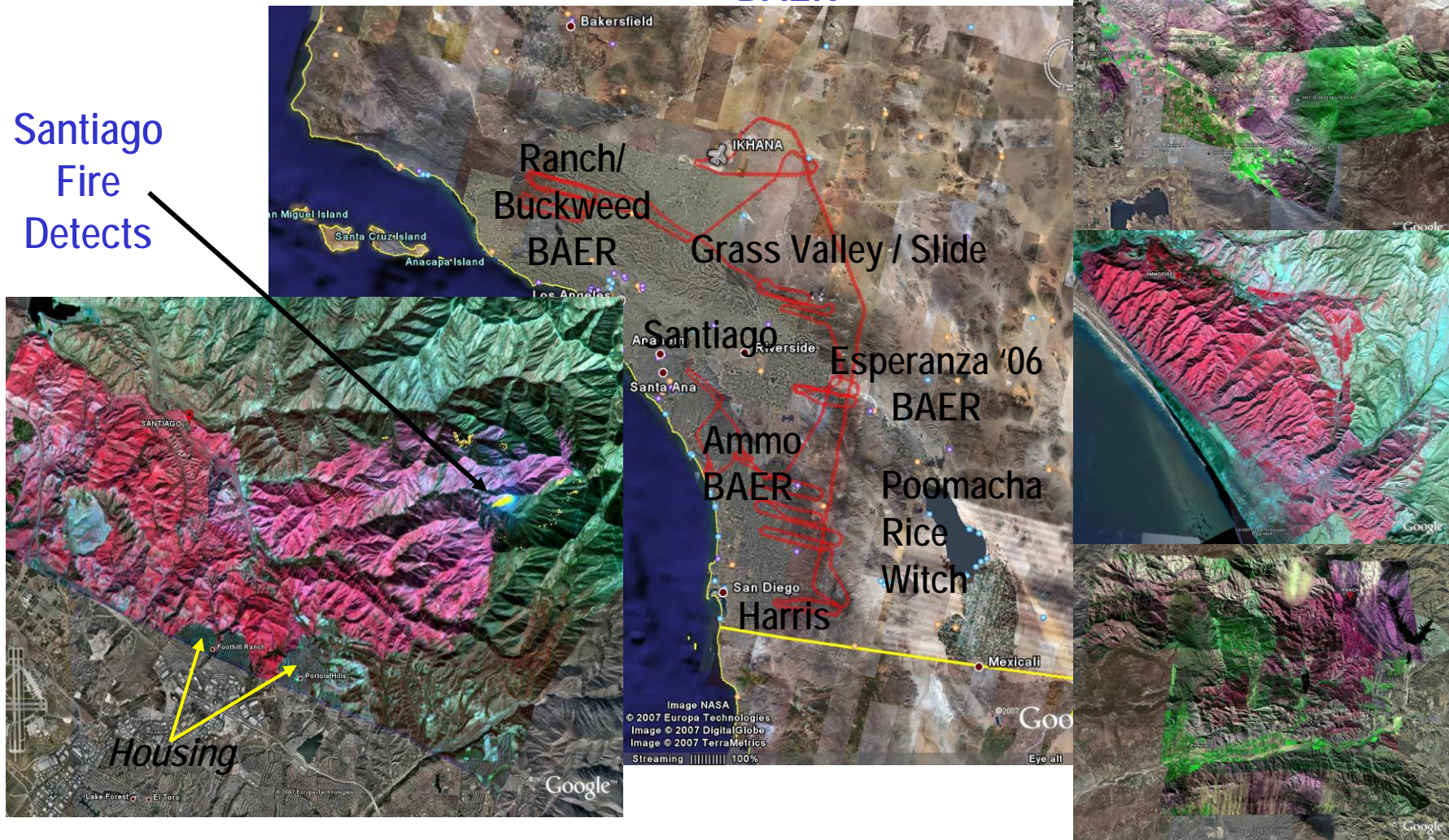
# WSFM #8 Emergency Response 2007



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Ranch, Ammo and Esperanza  
BAER

Santiago  
Fire  
Detects



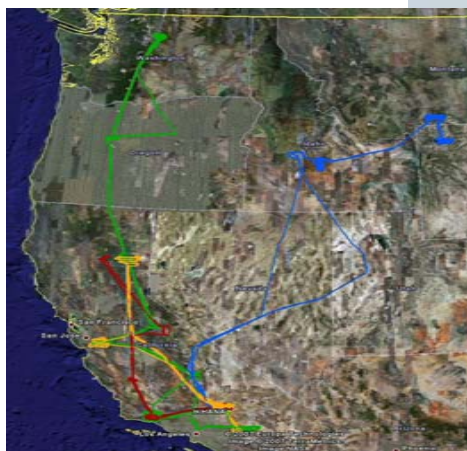




# WSFM Achievements



**IKHANA**



|               | Flight Date | Flight Duration | Fires Flown | Mileage NM |
|---------------|-------------|-----------------|-------------|------------|
| <b>WSFM 1</b> | 16 Aug      | 9.5 hrs         | 4           | 1400       |
| <b>WSFM 2</b> | 29 Aug      | 16.1            | 5           | 2500       |
| <b>WSFM 3</b> | 7 Sept      | 20              | 11          | 3200       |
| <b>WSFM 4</b> | 27 Sept     | 9.9             | 4           | 1800       |
| <b>WSFM 5</b> | 24 Oct      | 9               | 9           | ~1350      |
| <b>WSFM 6</b> | 25 Oct      | 8.7             | 8           | ~1350      |
| <b>WSFM 7</b> | 26 Oct      | 7.8             | 8           | ~1350      |
| <b>WSFM 8</b> | 28 Oct      | 7.1             | 11          | ~1350      |



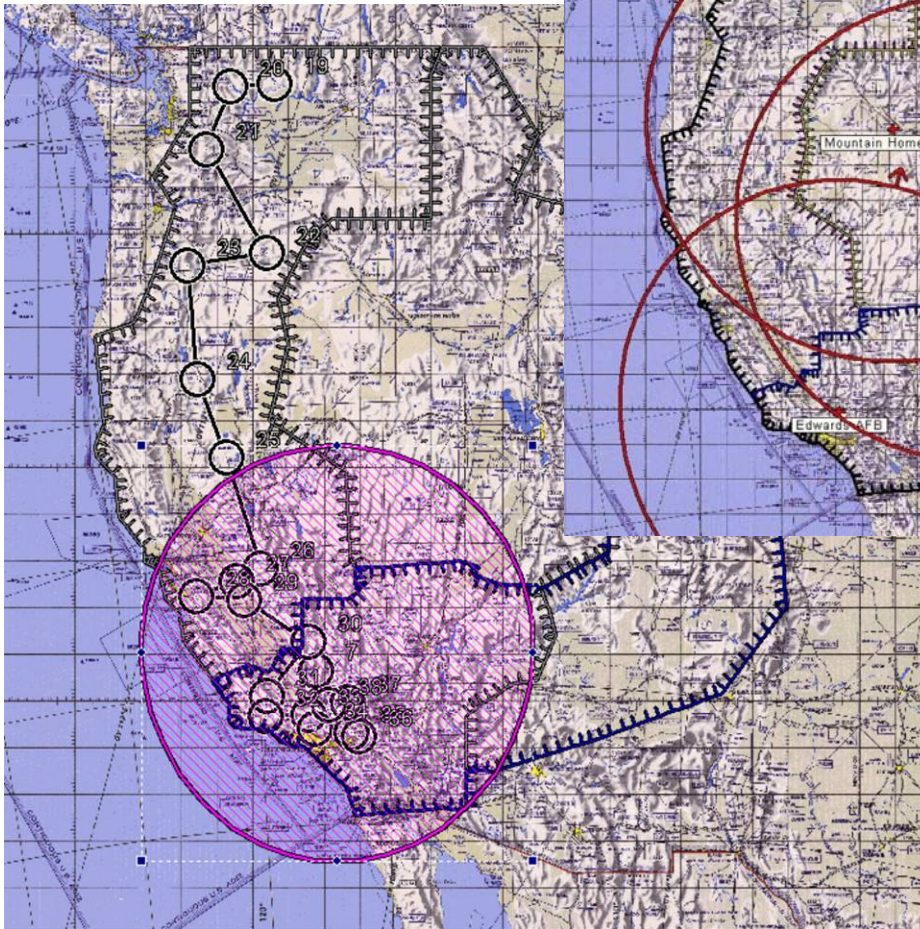


# WSFM Challenges

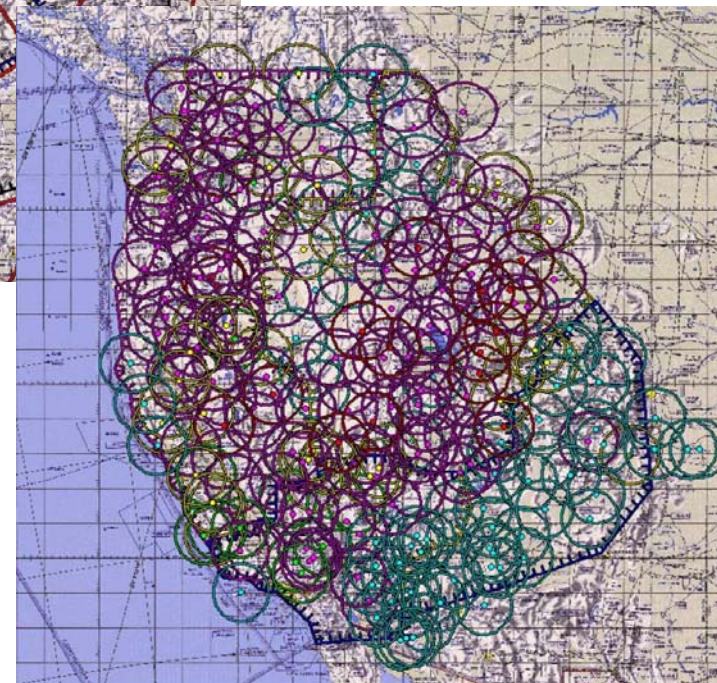


## IKHANA

Operational



Planning







## *WSFM Conclusions and Kudos*



**IKHANA**

